

**Technical Memorandum****URS OPERATING SERVICES****Containment of sources****Upper Animas Mining District, San Juan County, Colorado**

Prepared For: Project File

Prepared By: Jeff Miller, Senior Environmental Scientist *J/M*

Date: January 20, 2012

**Introduction**

URS Operating Services, Inc. (UOS) was tasked under Technical Direction Document number 1008-13 to gather information for the evaluation of the Upper Animas Mining District with regard to the EPA's Hazard Ranking System (HRS) criteria, including the evaluation of source areas. The Upper Animas Mining District is located approximately 7 miles north of Silverton, in San Juan County, Colorado. UOS personnel (myself and Barry Hayhurst) conducted site activities the week of August 22, 2011. Site work included: source sample collection from the Gold King 7 Level Mine waste rock pile and calculation of the waste pile volume, evaluation of mineralogy in source waste rock piles, documentation of the surface water pathway from all identified sources, field documentation of fishing along the Animas River south of Silverton, and wetlands delineation and sensitive environment characterization on Cement Creek. This technical memorandum presents the findings of the source containment evaluation, with regards to the characteristics described within Section 4.1.2.1.2.11 and Table 4-2 of the HRS.

**Source Description**

The containment characteristics of the following sources were documented: Grand Mogul Mine, Mogul Mine, Red and Bonita Mine, and Gold King 7 Level Mine. Numerous other sources exist within the Upper Animas Mining District, but were not visited during the August 2011 field work and are not described here. Each of the above source areas is described separately below:

**Grand Mogul Mine:** The Grand Mogul Mine source area consists of three waste rock piles and an aqueous discharge that begins at the toe of the east waste rock pile and flows generally to the west, along the toe of the pile (Photo 1) before joining Cement Creek. It is presumed that the discharge originates at a collapsed or buried adit beneath the east pile.

**Mogul Mine:** The Mogul Mine source area consists of a waste rock pile (Photo 2). The adit discharge flows from the toe of the waste rock pile, then flows across the mine waste rock to the west. Once the adit discharge crosses the road, it flows over mine trash into a series of wetlands below the road.


The discharge is located on the northeast side of a waste rock pile in a tarp-lined ditch, at the southeast corner of the waste pile. The discharge flows over a mixture of mine waste rock and gravel into Cement Creek.

**Red and Bonita Mine:** The Red and Bonita Mine source area consists of a tiered mine waste rock pile that is covered with a layer of the waste rock, the discharge is directed through a culvert beneath the road to the west. The discharge flows across a barren iron oxide stained landscape. During the fall of 2011, the adit was bulkheaded and the discharge was temporarily diverted to the south of the waste rock. After this work was completed, the discharge was allowed to resume its original flowpath as described above.

The discharge is from a discharging adit that flows down a slope, forming iron oxide precipitates. At the base of the waste rock pile, an access road, then is directed through a culvert, the discharge continues generally west. During the fall of 2011, the adit was bulk-

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**Source Description**

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**Grand Mogul Mine:** The Grand Mogul Mine source area consists of three waste rock piles and an aqueous discharge that begins at the toe of the east waste rock pile and flows generally to the west, along the toe of the pile (Photo 1) before joining Cement Creek. It is presumed that the discharge originates at a collapsed or buried adit beneath the east pile.

**Mogul Mine:** The Mogul Mine source area consists of an open adit on the northeast side of a waste rock pile (Photo 2). The adit discharge flows south across the top of the waste rock pile in a tarp-lined ditch, then flows across the mine waste rock to an access road at a point at the southeast corner of the waste pile. Once the adit discharge crosses the road, it flows west-southwest over a mixture of mine waste rock and mine trash into a series of wetlands below the mine before joining Cement Creek.

**Red and Bonita Mine:** The Red and Bonita Mine source consists of a discharging adit that flows down a tiered mine waste rock pile that is covered with an armored coating of iron oxide precipitates. At the base of the waste rock, the discharge is directed south along a ditch of an access road, then is directed through a culvert beneath the road to the west. From the end of the culvert, the discharge continues generally west across a barren iron oxide stained landscape to Cement Creek. During the fall of 2011, the adit was bulk-headed and the discharge was temporarily diverted to the south of the waste rock. After this work was completed, the discharge was allowed to resume its original flowpath as described above.

**Gold King 7 Level Mine:** The Gold King 7 Level Mine source area consists of a waste rock pile and two discharging adits. Both adits (east and west) discharge at the top of the pile. The larger east discharge is directed into a segmented plastic culvert that flows to the east across the top of the pile to a point near the eastern edge of the waste rock. At this point, the discharge exits the culvert and cascades down the waste rock at the eastern edge of the pile, and into the North Fork of Cement Creek which flows to the west near the base of the pile. The smaller western discharge is not provided with any engineering controls and flows westward eventually percolating down through the waste rock pile into the North Fork of Cement Creek. An access road bisects the western third of the pile from the southeast to the northwest, then curves around to the east onto the pile flat top surface.

### Source Containment

The containment characteristics of each source area described above are summarized below, with regards to the characteristics described within Section 4.1.2.1.2.11 and Table 4-2 of the HRS:

**Grand Mogul Mine:** The Grand Mogul waste piles did not have an engineered cover and were not vegetated (Photo 1). Any precipitation that falls on either pile would either flow down the surface of the pile or percolate into the material. No evidence of an engineered liner was observed and no functioning leachate collection and removal system associated with the pile was noted. No run-on control system was in place and the discharge that begins at the toe of the east pile flows directly adjacent to the base of the west pile (Photo 1).

**Mogul Mine:** The Mogul Mine waste rock pile did not have an engineered cover and was not vegetated (Photo 2). Any precipitation that falls on the pile would either flow down the surface of the pile or percolate into the material. Standing water was present on the flat upper surface of the pile during the site activities in August 2011 (Photo 2). No evidence of an engineered liner was observed and no functioning leachate collection and removal system associated with the pile was noted. The adit discharge flows south across the top of the waste rock pile within a tarp-lined ditch to an access road at a point at the southeast corner of the waste pile (Photo 2). The ditch tarp lining ends at the edge of the flat surface of the top of the pile. Once the adit discharge crosses the road, it flows southwest over a mixture of mine waste rock and timber into a series of wetlands below the mine, and then into Cement Creek.

**Red and Bonita Mine:** The tiered waste rock at the Red and Bonita Mine did not have an engineered cover and was only sparsely vegetated by pine trees on the flatten top of the pile (Photo 3). Much of the pile is covered with an armored coating of iron oxide precipitates, deposited by the adit discharge. It is likely that the coating would prevent some degree of percolation into the pile from both the discharge and precipitation, but any precipitation falling on uncoated portions of the pile would either percolate into the material or flow down its surface. No run-on control system was in place and ponded water from the discharging adit was present on the flat upper surface of the pile during the site activities in August 2011. The discharge has eroded channels into the pile (Photo 3). No evidence of an engineered liner was observed and no functioning leachate collection and removal system associated with the pile was noted.

**Gold King 7 Level Mine:** The Gold King 7 Level Mine waste pile did not have an engineered cover and was not vegetated (Photo 4). Standing water was present on the flat upper surface of the pile during the site activities in August 2011 (Photo 4). Any precipitation that falls on the pile would either flow down the surface of the pile or percolate directly into the material. No evidence of an engineered liner was observed. Both adits (east and west) discharge at the top of the pile. The larger east discharge is directed into a segmented plastic culvert that flows to the east across the top of the pile to a point near the eastern edge of the waste rock (Photo 4). At this point, the discharge exits the culvert and cascades down the waste rock at the eastern edge of the pile, and into the North Fork of Cement Creek which flows to the west at the base of the pile. A small berm has been constructed between the pile and North Fork of

Cement Creek, but a portion of the adit discharge is captured behind this berm and the water eventually discharges through a breach in the berm into the creek, just before the access road (Photo 4). Beneath the access road, the creek is actively eroding the base of the pile (Photo 5). The smaller western discharge is not provided with any engineering controls and flows westward a short distance before percolating down through the waste rock pile and eventually into the North Fork of Cement Creek.

### Photographs



**Photo 1:** East (bottom right) and west (middle right) waste rock piles of the Grand Mogul Mine source. Note discharge that originates at the bottom of the east pile where Jeff Miller (UOS) is standing, and discharges into Cement Creek in the middle of the photo. Looking west-northwest.



**Photo 2:** Panoramic photograph of the Mogul Mine area. The adit discharge can be seen flowing along the base of the slope at the far left, which is the eastern edge of the waste rock pile. Cement Creek flows from the just off the bottom right of the photo to the upper middle of the photo. Looking southwest.



**Photo 3:** The top of the Red and Bonita Mine source area, showing the adit discharge (bottom left) and the top of the waste rock pile (bright red). The discharge flows down the face of the pile to the access road (middle right), where it flows to the left of the photo (south), and then crosses beneath the road through culvert. From the end of the culvert, the discharge continues generally west across a barren iron oxide stained area to Cement Creek (flow upper right to upper left). Looking west-southwest.



**Photo 4:** The top of the Gold King Level 7 Mine source area, showing the east adit discharge in a culvert (lower right), the end of the culvert (bottom center), and the small berm at the bottom of the pile (bottom left corner). Water ponding behind the berm breeches the berm and discharges into the North Fork of Cement Creek (flowing from the bottom left to the middle) just before the access road. Looking west.





**Photo 5:** The bottom of the Gold King Level 7 Mine waste rock pile being actively eroded by the flow of the North Fork of Cement Creek. Jeff Miller (UOS) collecting GPS data from a sampling location.